Development of a Global Air Quality Satellite Constellation

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NON-EXPORT CONTROLLED
THESE ITEM(S) / DATA HAVE BEEN REVIEWED IN ACCORDANCE WITH THE INTERNATIONAL TRAFFIC IN ARMS REGULATIONS (ITAR), 22 CFR PART 120.11, AND THE EXPORT ADMINISTRATION REGULATIONS (EAR), 15 CFR 734(3)(b)(3), AND MAY BE RELEASED WITHOUT EXPORT RESTRICTIONS.
Air pollution is obvious to see…

A clear day in Beijing

A smoggy day in Beijing
The unseen effects of air pollution

- Air pollution causes 1 in 8 deaths globally
- Air pollution damages crops
- 92 per cent of the global population live in places with unhealthy air quality
The unseen effects of air pollution

Corporate Concerns of Pollution

- Liability Management
- Risk Mitigation
- Disaster Avoidance
- Compliance
- Corporate Social Responsibility
- Fiscal Responsibility
- Brand Management

Health Effects of Pollution

Accepted Effects:
- Shorter life
- Stroke
- Heart disease
- Asthma
- Lung cancer
- Reduced lung function
- Low birth weight

Possible Effects:
- Learning disabilities
- Alzheimer’s
- Depression
- Autism
- Obesity
- Birth defects
- Diabetes
### Use case: Healthcare

#### Air Quality Index Levels of Health Concern

<table>
<thead>
<tr>
<th>Health Concern</th>
<th>Numerical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0 to 50</td>
</tr>
<tr>
<td>Moderate</td>
<td>51 to 100</td>
</tr>
<tr>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>151 to 200</td>
</tr>
<tr>
<td>Very Unhealthy</td>
<td>201 to 300</td>
</tr>
<tr>
<td>Hazardous</td>
<td>301 to 500</td>
</tr>
</tbody>
</table>

**Today**

**Tomorrow**

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**Non-Export Controlled Information**
Use case: Monitoring and compliance
The limits of “free”
How can we improve monitoring?

• Develop a satellite constellation to provide global updates many times a day
Air Pollution:

- Particulates, ozone, nitrogen oxides, volatile compounds, carbon monoxide, CO$_2$ and methane

System of systems approach

- **Low-Flying Drones** up to 500 feet
- **Mid-Range UAVs** up to 12,000 feet
- **Aircraft** up to 45,000 feet
- **High-Flying UAVs** up to 60,000 feet
- **LEO Satellites** up to 500 miles
- **Ground** up to 30 feet
L3Harris space heritage

CrIS (On-Orbit Since 2011)
- 2211 spectral channels
- 3.9-15.4 microns
- 0.625 cm\(^{-1}\) resolution
- Superb on-orbit performance
- Four CrIS instruments expected in orbit

GOSAT-2 (2018 Launch)
- 10,380 channels
- 0.75-14.3 microns
- 0.2 cm\(^{-1}\) resolution

L3Harris HyperCube™
- 6U compatible
- SWIR / MWIR / LWIR
- 637 channels
## Hypercube™

### Deployable Passive Cooler for Detectors

### Instrument Section

### Spacecraft Section

### Deployable Solar Arrays

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Range</td>
<td>5.7 – 8.3 microns</td>
</tr>
<tr>
<td>Spectral Resolution</td>
<td>1.26 cm⁻¹</td>
</tr>
<tr>
<td>NEdN</td>
<td>0.15 mW/(cm⁻¹ m² sr)</td>
</tr>
<tr>
<td>Swath</td>
<td>1351 km</td>
</tr>
<tr>
<td>GSD</td>
<td>4.0 km; 20x20 array</td>
</tr>
<tr>
<td>Mass</td>
<td>5 kg</td>
</tr>
<tr>
<td>Power</td>
<td>20 W</td>
</tr>
</tbody>
</table>
Hypercube vs CrIS

CrIS Instrument

HyperCube CubeSat Prototype (Instrument Section)
High resolution example

- In this scenario, a single satellite provides high spatial and SNR.
Thank-you!

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